

Sorting and packaging



*Good practices in agriculture: social partners participation
in the prevention of musculoskeletal disorders.*

Table of contents

Introduction 3

1. Manual sorting 4

2. Washing 8

3. Grading and inspection 9

4. Bulk packing 12

5. Weighing 16

6. Internal transport 18

7. Manual handling instructions 21

General Information 23

Introduction

After the harvest, fruits and vegetables of all types have to be sorted, packaged and transported: apples, avocados, cherries, citrus, kiwifruit, onions, pears, peppers, potatoes, salad, strawberries, stone fruit, tomatoes, etc. The list is almost unlimited...

A wide range of technologies have been developed or refined over the years for sorting according to colour, density, diameter, shape and weight. Through the latest NIR (Near Infra Red) technology, pack houses can now even sort their product by indicators of product taste. Also some remarkable engineering developments have enabled the pack-house to be brought into the field and to progress through it with the harvesters.

However, still manual actions or inspections by workers have to be done and they may cause musculoskeletal disorders (MSD).

In this brochure we present to you, therefore, some solutions to reduce the risks leading to these disorders, which have been observed during the various stages of these post-harvest activities:

- Manual sorting
- Washing
- Grading and inspection
- Bulk packing
- Weighing
- Internal transport

Finally some recommendations are presented on how to practise correct working techniques.

This brochure does not claim to cover comprehensively all the possible good practices to alleviate or prevent MSDs during sorting and packaging of fruit and vegetables, but is the result of visits and meetings with farmers and commercial growers. There is no affiliation to commercial organizations or products in presenting these good practices.

We would like to thank all the farmers and growers that collaborated with us in this survey and we hope that all other farmers might learn from these practices to prevent musculoskeletal disorders in the future!

Project coordinator: Veerle Hermans

Project partners: Roeland Motmans, David O'Neill, Danuta Roman, Peter Lundqvist, Stefan Pinzke, Tomasz Tokarski, Agnès Luycx

1. Manual sorting

Sorting is often combined with grading, but in some applications both phases are separated from each other and the sorting phase is only for removing produce with surface deformities or blemishes and foreign / unwanted objects.

During this type of task, the worker usually stands in an upright position for long periods. The working height is fixed and unlikely to be adjustable to suit the particular height of the worker. This may cause continuous forward flexion and rotation of the neck and back. The alternative position is sitting on a chair, but then the upper body will probably be twisted.



Continuous standing with bending of neck and/or twisting the back.



Sitting on a chair, upper body and back twisted.

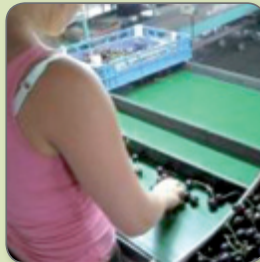
Solutions

Sorting table



A sorting table provides a good overview over the fruit as shown in the picture. The table can be self-made and/or adjustable to a correct working height. Too small and rotten fruit is sorted and discarded into a basket next to the table. An inclined table helps the fruit roll towards the sorter (into a basket) and thus avoids the need to reach forward. But, workers standing at the other side of the table should be avoided (see picture) since this will cause awkward shoulder postures for this person. Only a flat sorting surface is suitable when there are sorters at both sides.

Contrast for visual inspection



Most commercially available conveyors have a blue or green colour. However, e.g. for cherries, a white background is recommended. This provides a strong contrast between the fruit and conveyor and thus facilitates a more accurate sorting and less likely to induce fatigue.

Conveyor width



To reduce forward reaching and, consequently, increased shoulder/neck load, a conveyor width of less than 45 cm is recommended.

Wider conveyors can be recommended when used by several persons at both sides of the conveyor.

Antifatigue mat



Sorting the fruit in a standing position, on an industrial floor, can cause fatigue in the legs. Also during the other stages of sorting, grading and packaging, a softer surface can reduce the feeling of fatigue: a perforated rubber mat can be used to reduce leg and back fatigue. The mat will assist micro-movements of the feet and legs and thus sustained static postures are reduced.

Sitting



Another option to reduce leg and back fatigue is to alternate the standing position with a sitting posture. Sitting on a high chair reduces the weight on the feet and thus also fatigue in the legs. Alternation between standing and sitting working postures is also good for the back, because the continuous static load is relieved.

2. Washing

Certain types of produce may have to be washed before an accurate visual inspection can be carried out.

With the current desire in the horticultural industry to minimise the time taken from harvest to arrival on the supermarket shelf, the rigs described in the brochure 'harvesting' accommodate washing, sorting and packing stations.

However, not all crops are inspected and washed in the field. For many crops and fruits it is still appropriate to perform these operations on produce brought from the fields into the packing shed.

During the type of washing systems below, all what is left to do for the worker, is visual inspection and removal of unwanted objects, e.g. blemished fruit or clods of earth

Cherries sorting: the fruit is spread over the conveyor, which ensures a good overview.



Potato washer: after automatic washing and drying in the same machine, the potatoes are transferred by conveyor to the packing area.



3. Grading and inspection

Grading is often done by visual inspection, but may include a tactile component too, by a human operator who has been given a set of criteria against which to judge the item of produce. The criteria are: size, shape, colour, surface deformities or blemishes, firmness. Grading is expected to precede packaging because it is highly unlikely that items of significantly dissimilar quality would be acceptable in a small retail container.

Clustered fruit may have to be split before the actual grading and packaging can take place. When done manually, this causes a lot of repetitive movements of the arm and hand and continuous forward bending of the head and neck.

Automatic cutting reduces the high number of hand movements the worker has to make to split the clustered cherries.

When the fruit is transported on a conveyor belt, manual grading has to be performed. This causes a continuous forward bending of the neck and very high repetitive arm movements.



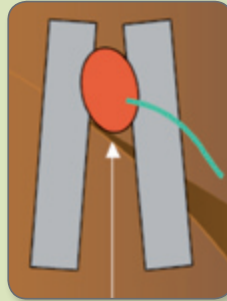
Manual grading of cherries: the smallest cherries are picked out and put at the distal section of the conveyor belt. At the end of the belt, the cherries drop into the appropriate trays. Continuous forward bending of the head and neck occurs.



Solutions

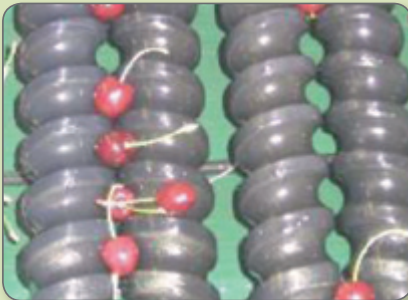
A variety of systems have been developed or refined over the years for automatic grading tasks to the extent that no manual handling occurs in the grading process. Some examples are presented.

Widening bands



Rubber bands which become progressively wider can be used to grade cherries. Cherries of the same size will fall together between the bands. Different channels and outlets enable cherries of predefined sizes to be collected.

Spiral



A spiral with a changing diameter can also be used to grade the tree fruit. This is a less common method because it takes more time compared to the rubber bands.

Laser



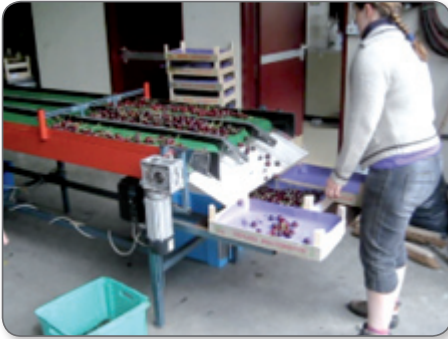
This type of laser takes up to 30 photographs or images of the fruit and can sort and grade on weight, colour, size and shape. Every piece of fruit is scanned. Their place on the conveyor is labelled and the fruit will be dropped at a predefined exit. Several exits can be defined based on the requirements of the client which can be programmed into the computer.

It should be mentioned that although automatic grading is possible, there will still be a small team of human operators watching in case there are any problems with the machines. For example, potatoes may have stones or clods of earth mixed in with them. Therefore inspection is a key activity.



4. Bulk packing

Bulk or loose filling of cartons or trays can be considered as the most cost effective packing system for packing fruit. At the end of the conveyor belt, after the sorting and grading, the fruit rolls automatically into trays or cartons. But, then, the worker has to lift each full tray, often bending forward in a risky posture for the back when the position of the tray is too low.



Solutions

Height adjustable support



To fit taller and smaller workers, the support of the tray has to be adjustable in height so that everybody can work between fist and elbow height. Some supports also have an integrated balance. It is possible that the end of the conveyor belt has also to be adjustable otherwise the fruit or vegetables will not roll easily into the trays.

Face the conveyor



Filling trays, crates or cartons manually above the conveyor is compatible with keeping a straight back, but the arms have to be lifted every time. This can be a problem when the conveyor is too high. Therefore, the shelf holding the crates has to be put as low as possible to avoid extreme upward arm lifting. Also an inclination of the shelf is helpful to avoid unnecessary or excessive reaching.

Lifting can be avoided if a full basket can be pushed to the side instead of lifted upwards.



With a tray beside the conveyor belt, the arms work in a more neutral position, but the back will be twisted repetitively.

Buffer



The graded fruit is collected in different exits. To avoid paced work, buffer zones are provided and automatic filling can be stopped for a certain period of time to remove a full tray, to go to the weighing machine etc.

As mentioned during sorting and grading, a conveyor width of less than 45 cm is recommended to avoid excessive forward reaching. However, a wide conveyor allows a larger flow per minute and is thus economically more efficient. Therefore, a guiding bar is necessary, to guide the fruit towards the packers at the appropriate locations, thereby reducing the demand for forward reaching.



Rotary tables



When the fruit arrives too fast, the rotary table provides a buffer and the worker can follow his or her own pace. When a technical error occurs, there should be enough time to solve it without stopping the conveyor.

A rotary table is also often used for hand placement packing of stone fruit; by constantly offering a range of fruit to the packers, there are more opportunities to ensure the packers can create a tray of good or consistent quality. This would be one of the many examples of packers acting as quality controllers on behalf of their employers.



5. Weighing

*When a fruit tray is filled, it has to be weighed and labelled.
When the balance stands beside the conveyor the worker
has to lift every box.*



Solutions

Push the tray on the balance



When the balance is next to the conveyor belt and at the same height, the tray or carton can be pushed on the balance.

Filling the basket on the balance



An even better practice to reduce manual lifting is to fill the box immediately on the balance and then push it onwards to the next step (internal transport). Also, the balance could have colour-coded read-out (left of the weighing platform) which avoids the need for the operator to read and interpret a number. Green colour means that the box is in the correct weight range. This means that when packing for different retailers, the operator does not have to remember a specific value, with tolerances, and read a scale but simply looks to see which light is illuminated. The computer software does the rest. This facilitates the mental load placed on the worker.

6. Internal transport

When the filled trays or cartons have to be lifted towards a pallet or trays have to be brought to the conveyor belt, a lot of back bending and lifting under knee height is found. Also reaching at or even above shoulder height is often observed.



Solutions

Scissor table



With a scissor table stooped working postures can be avoided or, at least, reduced. When the table can lower towards the ground / floor, every box can be placed at hip level without any extreme forward reaching.

Conveyor belt



After the weighing, the tray is pushed to the conveyor belt for further packaging. Although no lifting has to be done, be careful for the awkward posture due to the forward reaching and bending of the back.

In a fully mechanized sorting machine with scanners, labels with barcodes are put on the tray, and the tray will be guided to the right destination.

Transpallet

Carrying boxes is avoided by the use of a transpallet to bring the sorted and packed fruit to, for example, the refrigerator.

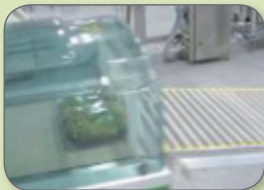


Forklift truck

In larger and more industrial settings, a forklift is likely to be used.



(Almost) automated packaging machine



There are many types of automated packaging machines. Some of them still involve some manual handling. The example given below is for pears:

A full palletbox arrives on the forklift truck and is placed at the intake of an automated packaging machine. A robot picks up the palletbox and puts it into the water. The fruit starts floating and a conveyor belt transports the fruit to the packaging conveyor. Another conveyor belt provides the trays in which the pears are placed (this is done manually to check the weight of the tray). Next, the fruit is wrapped automatically with plastic and a conveyor belt brings the packaged fruit to a turning table. Another operator stacks the trays into a carton and the full box is transported by a conveyor to the final exit where the robot places the carton on the pallet.

7. Manual handling instructions

Sorting and packaging tasks are often highly repetitive and associated with difficult working postures and movements, strenuous and static muscle loads. It is important to prepare for the physically demanding work and to help prevent musculoskeletal disorders by being physically fit, well-trained and knowing how to practise correct working techniques. Learn how to practice correct working techniques so they become natural for you

- *Keep your body in good trim by regular physical exercise*
- *Do not use more muscle strength than the task requires*
- *Warm up and stretch your muscles before and after the working shift*
- *Alternate work tasks with your colleagues and take short breaks - often*
- *Work near your body use both hands or alternate, and avoid extending your joints to more distal positions*
- *Lifting a load – put your feet around the load, keep the load close to your body, bend your knees AND keep your back straight*
- *Carrying a load – if possible divide the weight equally between your hands or carry the load symmetrically*
- *Turning with a load - move your feet instead of twisting your back*
- *Avoid lifting above shoulder height*
- *Use support*
- *Provide or use aids or helping devices*

Golfers technique

When it is not possible to bend the knees during lifting, and the pallet box cannot be lifted to the correct height and inclination, the golfers technique is a good alternative. Swing one leg upward, so it can act as a counter balance. However, special care must be taken if the floor or ground surface may be slippery as this is an inherently unstable posture.



Avoid reaching, use a helping device, e.g. a stick



Automatic supply is a nice idea, but with all the conveyors excessive reaching is likely to occur, especially for workers of smaller stature. A simple stick or tool for moving the produce (particularly if the force of gravity can be used to assist) may reduce excessive reaching.

Job rotation



There are several tasks in the company, several positions at the assembly line where different tasks have to be done. Rotation between workers can relieve some of the physical and mental load, if the tasks are sufficiently different from each other.

General information

This brochure is part of the project “Good practices in agriculture: social partners participation in the prevention of musculoskeletal disorders”, funded by the European Commission, DG Employment, social affairs and equal opportunities, call for proposal VP/2008/001. The Commission is not responsible for any use that may be made of the information contained in this brochure.

Ownership of the results of the action, including industrial and intellectual property rights, and of the reports and other documents relating to it shall be vested in the beneficiary (IDEWE non-profit).

Goal of the project is to implement the European social partners’ agreement of GEOPA-COPA and EFFAT by developing prevention policies and good practices to reduce musculoskeletal disorders in agriculture and to disseminate the results. For the following tasks good practices are presented:

- *Milking cows*
- *Tractor driving*
- *Ground level manual crops*
- *Pruning*
- *Sorting and packaging*
- *Harvesting*

For more information on the project: www.agri-ergonomics.eu.

Funded by:



European Commission
DG Employment, Social Affairs
and Equal Opportunities
1049 Brussels
Belgium
<http://ec.europa.eu/social>

Project coordinator:



IDEWE (non-profit)
External Service for Prevention and
Protection at Work
Interleuvenlaan 58
3001 Leuven
Belgium
www.idewe.be

Project partners:



Loughborough University
Department of Ergonomics (Human Sciences)
Leicestershire
LE11 3TU
United Kingdom
www.lboro.ac.uk



Central Institute for Labour Protection
National Research Institute
ul. Czerniakowska 16
00-701 Warszawa (Warsaw)
Poland
www.ciop.pl



Swedish University of
Agricultural Sciences

Swedish University of Agricultural Sciences
Department of Work Science, Business Economics
and Environmental Psychology
PO Box 88
SE-230 53 Alnarp
Sweden
www.slu.se



GEOPA - COPA
Rue de Trèves 61
1040 Brussel
Belgium
www.copa-cogeca.eu

Supported by:



EFFAT